PCI-DAS08

User's Manual

Revision 2

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1 INTRODUCTION

The PCI-DAS08 is a low cost analog input board for PCI bus compatible computers. Offering eight single-ended 12-bit analog inputs with sample rates up to 50 kHz and A/D resolution of 2.44 mV. The board also provides four digital output bits, three digital input bits, and three, 16-bit down-counters (in the form of a single 82C54 chip). The PCI-DAS08 is connector-compatible with Measurement Computing's highly popular ISA-based CIO-DAS08 board and is supported by the same wide variety of external signal conditioning products.

The PCI-DAS08 is completely plug-and-play. There are no switches, jumpers, or potentiometers on the board. All board addresses, interrupt channels etc. are set by your computer's plug-and-play software.

The PCI-DAS08 is fully supported by the powerful Universal Library software driver library as well as a wide variety of application software packages including SoftWIRE, DAS Wizard, and HP VEE.

2 INSTALLATION

2.1 SOFTWARE

The simplest way to configure your board is to use the *Insta*Cal™ program provided on the CD (or floppy disk).

*Insta*Cal will create a configuration file that your application software (and the Universal Library) will refer to so the software you use will automatically have access to the exact configuration of the board.

Please refer to the *Extended Software Installation Manual* regarding the installation and operation of *Insta*Cal. The following hard copy information is provided as a matter of completeness.

2.2 HARDWARE

The PCI-DAS08 is completely plug and play. There are no switches or jumpers to set before installing the board in your computer. Simply follow the steps shown below to install your PCI hardware.

1. Turn your computer off, unplug it, open it up and insert the PCI board into any available PCI slot.
2. Close your computer up, plug it back in and turn it on.
3. Windows will automatically detect the board as it starts up. If the board's configuration file is already on the system, it will load without user interaction. If the configuration file is not detected, you will be prompted to insert the disk containing it. The required file is on the InstaCal or Universal Library disk you received with your board. Simply insert the CD (or Disk 1 if your software is on floppy disk) into an appropriate drive and click on *CONTINUE*. The appropriate file should then be automatically loaded and the PCI board will appear in the Device Manager under DAS Component.

If the file is not found on the first attempt, use the browse function to select the drive that contains the InstaCAL or Universal Library disk, select the CBxx.INF file and then click on *CONTINUE.*

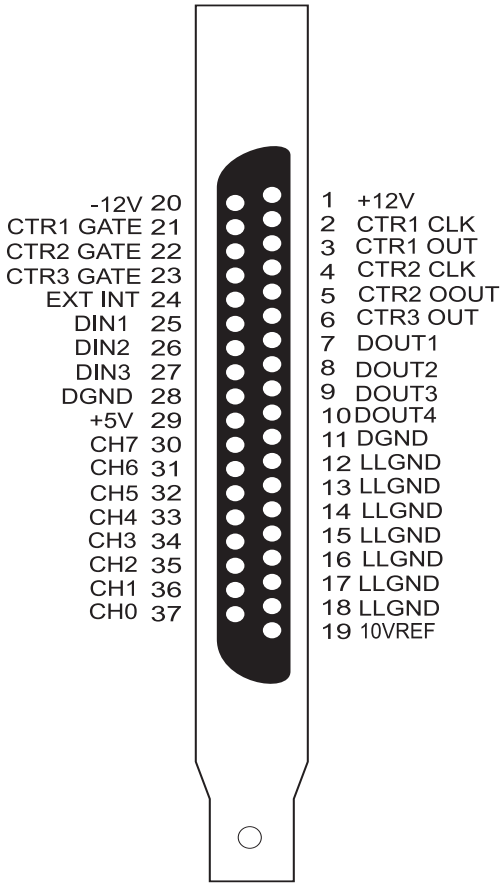
3 HARDWARE CONNECTIONS

3.1 CONNECTOR PIN DIAGRAM

The PCI-DAS08 board uses a male, 37-pin, "D" I/O connector. The PCI-DAS08 is fully connector-compatible with the CIO-DAS08, and is easily connected to the same variety of external signal conditioning products. The pinout of the connector is shown below.

Please make accurate notes and pay careful attention to wire connections. In a large system, a misplaced wire may create hours of work locating the problem.

Figure 3-1. 37-Pin Connector Pinout



3.2 CONNECTING SIGNALS TO THE PCI-DAS08

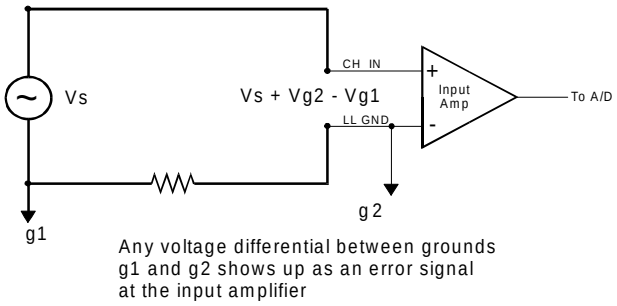
The simplest way to connect signals to the PCI-DAS08 is via the C37FF-x series cable and the CIO-MINI37 screw terminal board. The PCI-DAS08 (via the C37FF-X cable) is also compatible with a wide variety of external signal conditioning boards. These include the CIO-EXP16, CIO-EXP32, CIO-EXP-RTD16, CIO-EXP-BRIDGE16 and ISO-RACK08.

4 ANALOG CONNECTIONS

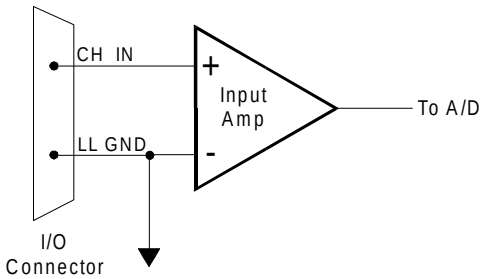
This section is designed to help you achieve the optimum performance from your PCI-DAS08 series board.

Please note that the PCI-DAS08 inputs are single-ended only. In some applications, this may make the PCI-DAS08 less suitable than a board that provides differential inputs.

A single-ended input measures the voltage between the input signal and ground. In this case, in single-ended mode the PCI-DAS08 measures the voltage between the input channel and LLGND. The single-ended input configuration requires only one physical connection (wire) per channel and allows the PCI-DAS08 to monitor more channels than the (2-wire) differential configuration using the same connector and onboard multiplexer. However, since the PCI-DAS08 is measuring the input voltage relative to its own low level ground, single-ended inputs are more susceptible to both EMI (Electro Magnetic Interference) and any ground noise at the signal source. The following diagrams show the single-ended input configuration.



Single-ended input with Common Mode Voltage



Single-Ended Input

Figure 4-1. Single-Ended Analog Input Theory

WARNING

If either the AC or DC voltage is greater than 5 volts, do not connect the PCI-DAS08 to this signal source. You are beyond the boards usable input range and will need to either adjust your grounding system or add special Isolation signal conditioning to take useful measurements. A ground offset voltage of more than 30 volts will likely damage the PCI-DAS08 board and possibly your computer. Note that an offset voltage much greater than 30 volts will not only damage your electronics, but it may also be hazardous to your health.

5 PROGRAMMING & SOFTWARE APPLICATIONS

Your PCI-DAS08 is supported by the powerful Universal Library. We strongly recommend that you take advantage of the Universal Library as your software interface. The complexity of the registers required for automatic calibration combined with the PCI BIOS's dynamic allocation of addresses and internal resources makes the PCI-DAS08 series very challenging to program via direct register I/O operations. Direct I/O programming should be attempted only by very experienced programmers.

Except for the registers required to implement plug-and-play, the PCI-DAS08 is compatible with the CIO-DAS08 board registers. However, due to the dynamic nature of base addresses on the PCI bus, software written at the register level for the CIO-DAS08 board may not work reliably on the PCI-DAS08. However, software written based on the Universal Library will work with the PCI-DAS08 with few or no changes.

5.1 PROGRAMMING LANGUAGES

The Universal Library provides complete access to the PCI-DAS08 functions from the full range of Windows programming languages. If you are planning to write programs, or would like to run the example programs for Visual Basic or any other language, please turn now to the Universal Library manual.

5.2 PACKAGED APPLICATION PROGRAMS

Many packaged application programs, such as SoftWIRE and HP-VEE have drivers for the PCI-DAS08. If the package you own does not appear to have drivers for the PCI-DAS08 please fax or e-mail the package name and the revision number from the install disks. We will research the package for you and advise how to obtain PCI-DAS08 drivers.

Some application drivers are included with the Universal Library package, but not with the Application package. If you have purchased an application package directly from the software vendor, you may need to purchase our Universal Library and drivers. Please contact us for more information on this topic.

6 PCI-DAS08 REGISTER DESCRIPTION

6.1 REGISTER OVERVIEW

PCI-DAS08 operation registers are mapped into I/O address space. Unlike ISA bus designs, this board has *several* base addresses each corresponding to a reserved block of addresses in I/O space. As we mention in our programming chapter, we highly recommend customers use the Universal Library package. Direct register-level programming should be done only by experienced programmers.

Of six Base Address Regions (BADR) available in the PCI 2.1 specification, two are implemented in this design and are summarized as follows:

I/O Region	Function	Operations
BADR1	PCI Controller Operation Registers	32-bit double word
BADR2	General Control/Status Registers	16-bit word

BADR1 will likely be different on different machines. Assigned by the PCI BIOS, these Base Address values cannot be guaranteed to be the same even on subsequent power-on cycles of the same machine. All software must interrogate BADR1 at run-time with a READ_CONFIGURATION_WORD instruction to determine the BADRn values.

6.2 BADR1

BADR1 is reserved for the 9052 PCI Controller operations. There is no reason to access this region of I/O space for most PCI-DAS08 users. The installation procedures and Universal Library access all required information in this area. Unless you are writing direct register level software for the PCI-DAS08, you will not need to be concerned with BADR1 address.

6.2.1 Interrupt Status and Control

BADR1 + 4Ch

This register is 32-bits long. Since the rest of the register has specific control functions, they need to be masked off in order to access the interrupt control functions.

READ/ WRITE

31:8	7	6	5	4	3	2	1	0
X	X	PCIINT	X	X	X	INT	INTPOL	INTE

INTE is the Interrupt Enable: 0 = disabled, 1 = enabled (default).
INTPOL is the Interrupt Polarity: 0 = active low (default), 1 = active high.
INT is the Interrupt Status: 0 = interrupt is not active, 1 = interrupt is active.
PCIINT is the PCI Interrupt Enable: 0 = disabled, 1 = Enabled (default).

6.2.2 Interrupt Source Select

BADR1 + 50h

This register, as with all the 9052 registers, is 32-bits long. Therefore, mask off the remaining bits in order to access the OUT0 general purpose I/O bit.

31:8	7	6	5	4	3	2	1	0
X	X	X	X	X	X	OUT0	1	0

Bit 0 enables the OUT0 function: 0 = enabled, 1 = disabled. Set it to "0".
Bit 1 selects the OUT0 bit direction: 0 = input, 1 = output. Set it to "1".
OUT0 selects the source for the interrupt OUT0 = 0, Interrupt input = user connector
OUT0 = 1, Interrupt input = Counter 2 output.

6.3 BADR2

In addition to the BADR1 registers, the PCI-DAS08 uses eight consecutive addresses in the PCI I/O space. The table below summarizes this address map. The remainder of this chapter has details on the function and usage of each of the registers. *Note that these registers are identical to those of the CIO-DAS08.*

REGISTER	READ FUNCTION	WRITE FUNCTION
BADR2 + 0	A/D bits 9 - 12 (LSB)	Start 8 bit A/D Conversion
BADR2 + 1	A/D bits (MSB) 1 - 8	Start 12 bit A/D Conversion
BADR2 + 2	EOC, IP1-3, IRQ, Mux address	OP1-4, INTE, Mux address, clear interrupt
BADR2 + 3	Not Used	Not Used
BADR2 + 4	Read Counter 0 Data	Write Counter 0 Data
BADR2 + 5	Read Counter 1 Data	Write Counter 1 Data
BADR2 + 6	Read Counter 2 Data	Write Counter 2 Data
BADR2 + 7	No Readback	Control Register

6.3.1 A/D DATA REGISTERS

BADR2 + 00h

READ/WRITE

7	6	5	4	3	2	1	0
A/D9	A/D10	A/D11	A/D12	0	0	0	0

READ

Contains the least significant four bits of the Analog input data.

WRITE

Writing any data to this register causes an immediate 8-bit A/D conversion.

BADR2 + 01h

READ/WRITE

7	6	5	4	3	2	1	0
A/D1	A/D2	A/D3	A/D4	A/D5	A/D6	A/D7	A/D8

READ

Contains the most significant byte of the analog input data.

The A/D bits code correspond to the voltage on the input according to the table below:

DECIMAL	HEX	VOLTAGE INPUT
4095	FFF	+ 5 Volts
2048	800	0 Volts
0	0	− 5 Volts

WRITE

Writing any data to this register causes an immediate 12 bit A/D conversion.

6.3.2 STATUS AND CONTROL REGISTER

BADR2 + 02h

READ

7	6	5	4	3	2	1	0
EOC	IP3	IP2	IP1	IRQ	MUX2	MUX1	MUX0

EOC End of conversion. 0 = A/D is not busy and data may be read, 1 = A/D is busy.

IP3:1 Digital input bits.

IRQ Interrupt status. 1 = positive edge detected on INT line. 0 = cleared, by writing to BADR2 +2h.

MUX2:0 Current Multiplexer channel, binary-coded between 0 and 7.

WRITE

7	6	5	4	3	2	1	0
OP4	OP3	OP2	OP1	INTE	MUX2	MUX1	MUX0

OP4:1 Digital output bits.

INTE Interrupt enable to the PC bus. 1 = interrupts are enabled, 0 = disabled.

MUX2:0 Sets current Multiplexer channel, binary-coded between 0 and 7.

Writes to this address also clear the interrupt status bit IRQ (described above)

6.3.3 8254 COUNTER 0 (user COUNTER 1) DATA

BADR2 + 04h

READ/WRITE

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

6.3.4 8254 COUNTER 1 (user COUNTER 2) DATA

BADR2 + 05h

READ/WRITE

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

6.3.5 8254 COUNTER 2 (user COUNTER 3) DATA

BADR2 + 06h

READ/WRITE

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

6.3.6 8254 CONTROL REGISTER

BADR2 + 07h

WRITE ONLY

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

The control register is used to set the operating Modes of 8254 Counters 0,1 & 2. A counter is configured by writing the correct Mode information to the Control Register, then writing the proper count data to the specific Counter Register. The Counters on the 8254 have 16-bits. Since the interface to the 8254 is only 8-bits wide, Count data is written to the Counter Register as two successive bytes. Write the low byte first, then the high byte. The Control Register is 8-bits wide. Further information can be obtained on the 8254 data sheet from Intel or Harris.

7 SPECIFICATIONS

Typical specifications for 25 DegC unless otherwise specified.

Power consumption

+5V Operating (A/D converting to FIFO)	251 mA typical, 436 mA max
+12V	13 mA typical, 19 mA max
-12V	17 mA typical, 23 mA max

Analog input section

A/D converter type	AD1674J
Resolution	12 bits
Ranges	±5V
A/D pacing	Software polled
A/D Triggering Modes	
Digital	Software polling of digital input followed by pacer loading and configuration.
Data transfer	Software polled
Polarity	Bipolar
Number of channels	8 single-ended
A/D conversion time	10µs
Throughput	40KHz typical, PC dependent
Relative Accuracy	±1LSB
Differential Linearity error	No Missing Codes guaranteed
Integral Linearity error	±1 LSB
No missing codes guaranteed	12 bits
Gain drift (A/D specs)	±180ppm/°C
Zero drift (A/D specs)	±60ppm/°C
Input leakage current	±60 nA max over temperature
Input impedance	10Meg Ohms min
Absolute maximum input voltage	±35V

Noise Distribution (Rate = 1-50KHz, Average % ±2 bins, Average % ±1 bin, Average # bins)

Bipolar (5V)	100% / 100% / 3 bins

Digital Input / Output

Digital Type (Main connector)	
Output	74ACT273
Input	74LS244
Configuration	3 fixed input, 4 fixed output
Number of channels	7
Output High	3.94 volts min @ -24mA (Vcc = 4.5V)
Output Low	0.36 volts max @ 24mA (Vcc = 4.5V)
Input High	2.0 volts min, 7 volts absolute max
Input Low	0.8 volts max, -0.5 volts absolute min
Interrupts	INTA# - mapped to IRQn via PCI BIOS at boot-time
Interrupt enable	Programmable through PCI controller; 0 = disabled, 1 = enabled (default)
Interrupt sources	External source (EXT INT), polarity programmable through PCI controller; 1 = active high, 0 = active low (default)

Counter section

Counter type	82C54
Configuration	82C54 device. 3 down counters per 82C54, 16 bits each 82C54: Counter 0 - User Counter 1 Source: Available at user connector (CTR1CLK) Gate: Available at user connector (CTR1GATE) Output: Available at user connector (CTR1OUT) Counter 1 - User Counter 2 Source: Available at user connector (CTR2CLK) Gate: Available at user connector (CTR2GATE) Output: Available at user connector (CTR2OUT) Counter 2 - User Counter 3 or Interrupt Pacer Source: Buffered PCI Clock (33MHz) divided by 8. Gate: Available at user connector (CTR3GATE) Output: Available at user connector (CTR3OUT) and may be software configured as Interrupt Pacer.
Clock input frequency	10Mhz max
High pulse width (clock input)	30ns min
Low pulse width (clock input)	50ns min
Gate width high	50ns min
Gate width low	50ns min
Input low voltage	0.8V max
Input high voltage	2.0V min
Output low voltage	0.4V max
Output high voltage	3.0V min

Environmental

Operating temperature range	0 to 50 °C
Storage temperature range	-20 to 70 °C
Humidity	0 to 90% non-condensing

EC Declaration of Conformity

We, Measurement Computing Corp., declare under sole responsibility that the product:

PCI-DAS08	Low Cost analog input board for the PCI bus
Part Number	Description

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

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